

Marketing Research Report No. 1011

Costs of Building and Operating Rice Drying and Storage Facilities in the South

U.S. Department of Agriculture
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ABSTRACT

Capital requirements and operating costs were analyzed using economic-engineering techniques to develop average cost curves for concrete upright type commercial rice dryers with storage capacities of approximately 100,000, 300,000 and 600,000 hundredweight. Capital requirements ranged from over three-quarters of a million dollars for the 100,000 hundredweight facility to over 2 million dollars for the 600,000 hundredweight plant. Taken in order of plant size, the operating costs--based on estimated receipts of 135 percent of net storage capacity--were \$1.02, \$0.60, and \$0.49 per hundredweight.

The 100,000 hundredweight plant could not cover costs even at a receipt level equivalent to 1.8 times its net storage capacity. Break-even volumes for the 300,000, and 600,000 hundredweight facilities were approximately 1.5 and 1.2 times net storage capacity, respectively.

Keywords: Rice, grain elevators, Southern Region, economic engineering, cost functions, economy of scale.

PREFACE

This study is part of a research program designed to provide useful information and analyses to policymakers and the rice industry. Specifically, it provides information on investment requirements and operating costs for commercial rice dryers of different sizes operating at various levels of capacity. The volume-cost relationships will also provide improved data inputs for systems model analysis useful in determining optimum industry organization.

The detailed input requirements of studies of this nature necessitate close cooperation of numerous industry personnel. The authors express their appreciation for the help and advice of those administrative personnel, rice dryer managers and foremen, and engineering firms consulted during the course of this study. Also, special thanks are expressed to Carl J. Vosloh, Jr., for his assistance in developing some of the cost data and underlying assumptions and to William A. Faught for his contributions in planning and implementing early phases of the study.

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SUMMARY AND CONCLUSIONS

New rice-drying facilities need to have a capacity of at least 300,000 hundredweight to be economically feasible, according to findings based on a simulation analysis of three sizes of models with average gross revenue of \$0.56 per hundredweight. Even larger capacities appear to be necessary to make them attractive as investments.

The small model (with approximately 100,000 hundredweight capacity) could not cover total costs even if annual rice receipts were as much as 1.8 times net storage capacity. Including the allowance for interest on investment, the medium-size dryer (300,000 hundredweight capacity) would earn about 7 percent on its invested capital at its maximum estimated receipt level of 554,042 hundredweight. This is somewhat less than could be earned on long-term bonds. To break even, the medium and large models (600,000 hundredweight capacity) would need to have receipts of about 1.5 and 1.2 times net storage capacity, respectively.

Total capital requirements for the simulated small, medium, and large concrete upright type commercial rice dryers were about \$777,000, \$1,425,000, and \$2,310,000, respectively. Investment for equipment averaged about 44 percent of total plant costs. Investment cost per hundredweight of net storage capacity ranged from \$7.88 for the small model to \$3.81 for the large model. Investment cost per bushel was \$3.55 and \$1.71, respectively, for the same model sizes.

Costs were developed at four volume levels equivalent to annual receipts of 45 to 180 percent of net storage capacity. At the 135 percent level, total costs for the small, medium, and large models averaged approximately \$1.02, \$0.60, and \$0.49 per hundredweight, respectively. Out-of-pocket costs (total costs excluding depreciation and interest on investment) at this volume level were \$0.42, \$0.26, and \$0.21, respectively.

COSTS OF BUILDING AND OPERATING RICE DRYING AND STORAGE FACILITIES IN THE SOUTH

by

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BACKGROUND

Over the past 30 years, there has been over a threefold increase in rice production in the United States. During this period, rice-harvesting methods have progressed from threshing and field drying to self-propelled combines and artificial drying. The commercial rice-drying industry developed from the need for artificial drying. As production increased and the harvest season contracted, commercial rice dryers had to expand drying and storage capacity. Attempts to meet expanded capacity requirements with plants initially designed for a slower harvesting pace often resulted in inefficiencies in plant layout and labor utilization. This, coupled with increased cost of other variable and fixed cost inputs, continued to push the unit cost of operation upward. Although the unit cost of inputs increased steadily, competition caused rice dryer operators to continue to provide services for a number of years without raising charges.

PROBLEMS AND OBJECTIVES

The commercial rice-drying industry in general--and the management in particular--face a number of problems. Among them are: (1) A continually rising per unit cost of operation, coupled with service charges which have not kept pace; (2) reduced profit margins, which have intensified the effects of reduction in volume; (3) the need to replace outmoded plants and equipment; and (4) the need to match plant size to anticipated receipts for maximum economy of operation. Detailed economic analyses relating to these problems can provide management with information useful in making decisions. Economic analysis using locational models can help determine the best number, size, and location of plants. 2/

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2/ Shelby H. Holder, Jr., Dale L. Shaw, and James C. Snyder. A Systems Model of the U.S. Rice Industry, U.S. Dept. Agr., Econ. Res. Serv., Tech. Bul. No. 1453, Washington, D.C., Nov. 1971.

However, management also needs detailed information on comparative costs and economies of plants of different sizes operating at various levels of capacity. Thus, the specific objectives of this study are to: (1) Develop total capital requirements for concrete upright type commercial rice dryers of specified sizes; (2) develop operating costs for each model at four volume levels; and (3) determine average cost curves and economies of scale.

MODEL SPECIFICATIONS

Commercial rice dryer designs and layouts are almost as numerous as the number of facilities. However, regardless of design, each plant must be capable of receiving, drying, storing, and shipping rough rice. Efficiency of each of these functions is largely influenced by the age of the plant and equipment and by the layout and design of the plant.

Once moisture content of rough rice is reduced to a safe storage level, usually around 12 to 13 percent, it is stored in either upright or flat facilities. A bin, or storage area, with a height greater than its diameter or width is generally designated as "upright." One having a diameter greater than its height is referred to as "flat." The upright type of storage facility is most common in the southern rice-growing States, while in California, or the western rice-growing region, a combination of upright and flat facilities is more common. ^{3/} This analysis is concerned with upright facilities with storage capacities of approximately 100,000, 300,000, and 600,000 hundredweight. (Those plants are hereafter referred to as the small, medium, and large plants, respectively.) These three sizes were selected as a result of discussions with industry management and design engineers. Those consulted felt that those model sizes would include the majority of sizes currently operating as single plants.

Adequate drying capacity is an extremely critical factor in designing an efficient commercial rice-drying facility. Since rough rice is commonly dried in several stages, at some point during the drying period it is necessary to dry 2 or 3 days receipts in a 24-hour period. This requirement, plus actual commercial dryer daily receipt data during the peak week of operation, was the basis used to size dryers for each model. Average daily receipts during the peak week (3.5 percent) were multiplied times maximum annual receipts and multiplied times 3 days (maximum receipts to be dried in a 24-hour period). This provided an estimate of the maximum drying requirements in a 24-hour period.

^{3/} Because of significant differences in design requirements and handling methods, facilities for California are being analyzed separately and a report will be published later.

As a basis for developing cost curves and determining impact of volume changes, operating costs were estimated for four levels of annual rough rice receipts, varying from 45 to 180 percent of net storage capacity (table 1).

CAPITAL REQUIREMENTS

A new commercial rice-drying facility is a major financial investment requiring a thorough investigation of capital needs. In addition to estimates of building and equipment costs, knowledge of operating costs is required to evaluate the economic feasibility of a particular plant. In this and the following section, estimates are made for capital requirements and for operating costs of the small, medium, and large model commercial rice-drying facilities.

Building

Estimated capital requirements for building the small, medium, and large models are approximately \$416,000, \$802,000, and \$1,304,000, respectively (table 2). Storage and handling tanks and headhouses account for the largest proportion of building investment costs, varying from about 84 percent for the small model to nearly 81 percent for the large model. 4/

Building investment costs include an estimate for foundation piling. Piling cost varies significantly by location, depending on soil conditions. However, since this expense can have a significant impact on construction cost, piling costs were estimated for each model. They vary from \$27,000 for the small model to \$157,000 for the large model. These costs are typical for much of the southern rice-growing area, where foundation piling is commonly required.

Equipment

Investments for equipment vary from about \$354,000 for the small model to \$982,000 for the large model (table 2). This amounts to about 46 and 42 percent of total building and equipment costs, respectively. Since plant design was based on the capability of receiving, drying, turning, and shipping simultaneously, equipment costs as a percentage of the total are slightly higher than for a facility not built to these specifications.

4/ See app. table 2 for separate costs of storage tanks and headhouses.

Table 1--Estimated annual rough rice receipts at specified levels of average occupancy, by model size

Model size	Average occupancy ^{1/}			
	10%		20%	
	Annual receipts ^{2/}	Capacity utilized ^{3/}	Annual receipts ^{2/}	Capacity utilized ^{3/}
	Cwt.	Percent	Cwt.	Percent
Small.....	44,323	45	88,646	90
Medium.....	138,510	45	277,021	90
Large.....	272,847	45	545,694	90
	30%		40%	
	Annual receipts ^{2/}	Capacity utilized ^{3/}	Annual receipts ^{2/}	Capacity utilized ^{3/}
	Cwt.	Percent	Cwt.	Percent
	Cwt.	Percent	Cwt.	Percent
Small.....	132,969	135	177,292	180
Medium.....	415,532	135	554,042	180
Large.....	818,545	135	1,091,392	180

^{1/} Average occupancy is the average monthly quantity of rice on hand during the year (app. table 7) divided by net storage capacity (app. table 1).

^{2/} Annual receipts from app. table 8.

^{3/} This percentage represents the ratio of annual receipts to net storage capacity. (See app. table 1 for net storage capacity of each model.)

Major equipment requirements for each function are itemized for the three model plants (app. tables 3-5). The most expensive items of equipment are the scale and dumper and the dryers.

Installed cost of an air pollution control system ranges from \$49,000 for the small model to over \$185,000 for the large model (table 2). These

estimates are for a complete dust control system, including dryers equipped with filter type collectors.

Other

Other investment costs which must be considered in developing total capital requirements are land, roads, and yard. Combined cost of these items is about 1 percent of the total investment cost of the plant.

Total Investment

Total building and equipment costs exceed \$776,000 for the small dryer and \$2,309,000 for the large model (table 2). Average investment per hundred-weight of net storage capacity for the small, medium, and large dryer is \$7.88, \$4.63, and \$3.81, respectively. The traditional economic relationship between plant capacity and per unit cost of building and equipment is more evident when seen in graphic form (fig. 1).

OPERATING COSTS

Total operating expenses are composed of two broad cost categories--fixed and variable. Fixed costs include such items as depreciation, insurance, taxes, licenses and bonds, and interest on investment. Variable costs include all items of expense which relate directly to volume handled. The more important of these are labor, administrative overhead, repairs, energy, and interest on working capital.

Total operating costs were developed for each model at four volume levels (tables 3-14). Per unit costs were determined by dividing the total costs by estimated annual receipts (app. table 8).

Fixed Costs

Because of high capital investment requirements for commercial rice dryers, fixed costs of depreciation and interest on investment have a significant impact on operating costs. For all three model sizes, total fixed cost as a percentage of total cost ranges from over 70 percent at the lowest volume level to approximately 61 percent at the highest volume level. Depreciation and interest on investment are the largest fixed-cost items, accounting for about 54 and 35 percent, respectively, of total fixed costs.

Table 2--Estimated total capital requirements for buildings and equipment,
by model size, Southern Region, 1971

Item	Model size		
	Small	Medium	Large
	Dollars		
Buildings:			
Storage tanks and headhouses...	351,235	659,612	1,055,571
Office and sample house <u>1/</u>	8,400	14,400	16,800
Miscellaneous--			
Dump pit and shed.....	3,500	3,500	7,000
Shop.....	6,000	6,000	6,000
Piling <u>2/</u>	27,000	80,000	157,000
Contingency (5%).....	19,807	38,176	62,119
Subtotal.....	415,942	801,688	1,304,490
Equipment:			
Receiving.....	90,690	121,429	256,688
Drying.....	87,810	152,755	202,654
Storing.....	33,943	69,145	111,657
Shipping.....	36,768	59,956	74,115
Miscellaneous--			
Air pollution control system:	49,000	105,500	185,576
Other <u>3/</u>	38,820	72,026	104,556
Contingency (5%).....	16,852	29,041	46,762
Subtotal.....	353,883	609,852	982,008
Other:			
Land <u>4/</u>	4,000	6,000	8,000
Roads and yard <u>5/</u>	2,500	7,000	14,000
Contingency (5%).....	325	650	1,100
Subtotal.....	6,825	13,650	23,100
Total investment.....	776,650	1,425,190	2,309,598
Average cost: <u>6/</u>			
Bushel (45 lbs.).....	3.55	2.08	1.71
Hundredweight.....	7.88	4.63	3.81
Barrel (162 lbs.).....	12.77	7.50	6.17

1/ Based on \$12 per square foot. 2/ Based on actual cost data and industry estimates. 3/ See app. tables 3-5 for other items included in miscellaneous equipment costs. 4/ Land valued at \$1,000 per acre. Acreages based on industry estimates. 5/ Based on industry estimates. 6/ Based on total net storage capacities (app. table 1).

Total fixed costs ranged from \$1.99 per hundredweight at the lowest volume level for the small dryer to \$0.24 per hundredweight at the highest volume level for the largest dryer (tables 3 and 14).

Variable Costs

Direct labor costs and administrative overhead are the most expensive variable cost items. These two items combined account for over 69 percent of total variable costs at the lowest volume level and over 56 percent at the highest volume level. Repairs to buildings and equipment are also significant items of expense, varying from about 10 percent of total variable cost at the lowest volume level to 16 percent at the highest volume level.

Total Costs

Average total cost for the small model ranges from \$2.67 to \$0.82 per hundredweight at the lowest and highest volume levels, respectively (tables 3 and 6). The corresponding range in costs for the medium and large models at these volume levels is \$1.57 to \$0.47 and \$1.28 to \$0.38, respectively.

Based on a 30 percent average occupancy (135 percent of net storage capacity), average total costs for the small, medium, and large models are approximately \$1.02, \$0.60, and \$0.49 per hundredweight, respectively (tables 5, 9, and 13). Corresponding out-of-pocket costs are \$0.43, \$0.26, and \$0.21.

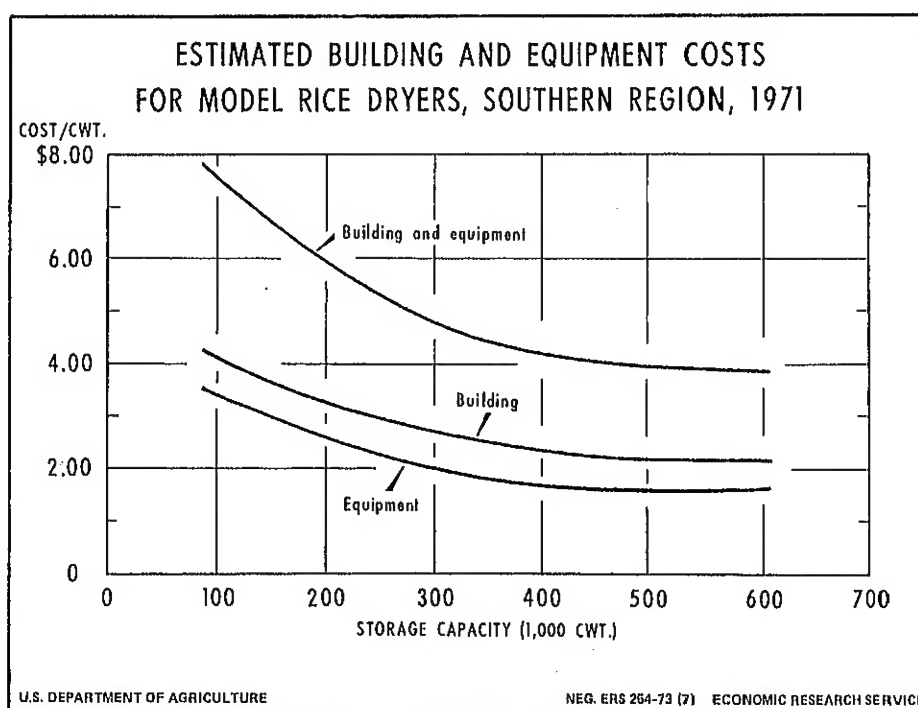


Figure 1

Table 3--Small model, 10 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 ^{1/}

Cost item	:Receiving: : by : truck	: Drying	: Storing	: Loading : out ^{2/}	: Total : cost
	<u>Cents per hundredweight</u>				
Fixed costs:					
Building depreciation.....	0.64	5.36	17.81	0.31	24.12
Equipment depreciation.....	21.76	31.32	15.41	14.56	83.06
Insurance--bldg. & equip. ...	.42	.96	1.60	.27	3.26
Taxes--bldg. & equip.	2.40	5.33	8.88	1.54	18.15
Licenses & bonds.....	.02	--	.44	--	.46
Interest on investment.....	9.34	20.68	34.40	6.03	70.45
Total fixed cost.....	34.58	63.66	78.54	22.72	199.50
Variable costs:					
Direct labor.....	2.40	8.79	12.87	2.19	26.25
Administrative overhead.....	1.96	7.17	10.51	1.79	21.43
Electricity.....	.18	1.52	.74	.08	2.52
Dryer fuel.....	--	1.10	--	--	1.10
Truck expense.....	--	.95	--	--	.95
Building repairs.....	.01	.13	.44	.01	.58
Equipment repairs.....	.96	1.71	2.94	.69	6.31
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.62	2.38	3.08	.53	6.61
Interest on working capital :	.16	.53	.73	.12	1.54
Total variable cost.....	6.29	24.28	31.54	5.41	67.53
Total cost.....	40.87	87.94	110.08	28.13	267.02
Out-of-pocket cost ^{3/}	9.13	30.58	42.46	7.23	89.39

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

^{1/} Costs in this table were obtained by dividing estimated total costs (app. table 15) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

^{2/} Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

^{3/} Excludes depreciation and interest on investment.

Table 4--Small model, 20 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 ^{1/}

Cost item	:Receiving: : by : truck	: Drying	: Storing	: Loading : out ^{2/}	: Total : cost
	Cents per hundredweight				
Fixed costs:					
Building depreciation.....	0.32	2.68	8.90	0.16	12.06
Equipment depreciation.....	10.88	15.66	7.71	7.28	41.53
Insurance--bldg. & equip. ...	.21	.48	.80	.14	1.63
Taxes--bldg. & equip.	1.20	2.67	4.44	.77	9.08
Licenses & bonds.....	.01	--	.22	--	.23
Interest on investment.....	4.67	10.34	17.20	3.02	35.22
Total fixed cost.....	17.29	31.83	39.27	11.36	99.75
Variable costs:					
Direct labor.....	1.25	4.75	7.66	1.12	14.79
Administrative overhead.....	.90	3.44	5.56	.81	10.72
Electricity.....	.13	1.09	.52	.06	1.80
Dryer fuel.....	--	1.02	--	--	1.02
Truck expense.....	--	.95	--	--	.95
Building repairs.....	.01	.13	.44	.01	.58
Equipment repairs.....	.88	1.57	2.69	.64	5.78
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.35	1.44	1.90	.29	3.99
Interest on working capital	.09	.30	.43	.07	.89
Total variable cost.....	3.62	14.69	19.44	3.00	40.76
Total cost.....	20.91	46.52	58.71	14.36	140.51
Out-of-pocket cost ^{3/}	5.04	17.84	24.91	3.91	51.70

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

^{1/} Costs in this table were obtained by dividing estimated total costs (app. table 16) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

^{2/} Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

^{3/} Excludes depreciation and interest on investment.

Table 5--Small model, 30 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : : truck :	: Drying :	: Storing :	: Loading : : out <u>2/</u> :	: Total : cost :
	Cents per hundredweight				
Fixed costs:					
Building depreciation.....	0.21	1.79	5.94	0.10	8.04
Equipment depreciation.....	7.25	10.44	5.14	4.85	27.69
Insurance--bldg. & equip. ...	.14	.32	.53	.09	1.08
Taxes--bldg. & equip. ....	.80	1.78	2.96	.51	6.05
Licenses & bonds.....	.01	--	.15	--	.15
Interest on investment.....	3.11	6.89	11.46	2.01	23.48
Total fixed cost.....	11.53	21.22	26.18	7.57	66.50
Variable costs:					
Direct labor.....	1.25	5.55	5.72	.78	13.29
Administrative overhead.....	.77	3.43	3.54	.48	8.22
Electricity.....	.11	.92	.44	.05	1.52
Dryer fuel.....	--	.99	--	--	.99
Truck expense.....	--	.95	--	--	.95
Building repairs.....	.01	.13	.44	.01	.58
Equipment repairs.....	.80	1.43	2.45	.58	5.26
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.33	1.49	1.42	.21	3.45
Interest on working capital :	.07	.30	.31	.05	.73
Total variable cost.....	3.35	15.19	14.56	2.15	35.25
Total cost.....	14.87	36.41	40.74	9.73	101.74
Out-of-pocket cost <u>3/</u>	4.30	17.29	18.20	2.77	42.53

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 17) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Excludes depreciation and interest on investment.

Table 6--Small model, 40 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 ^{1/}

Cost item	:Receiving: : by : truck	: Drying	: Storing	: Loading: : out ^{2/}	Total cost
	<u>Cents per hundredweight</u>				
Fixed costs:					
Building depreciation.....	0.16	1.34	4.45	0.08	6.03
Equipment depreciation.....	5.44	7.83	3.85	3.64	20.76
Insurance--bldg. & equip....	.10	.24	.40	.07	.81
Taxes-bldg. & equip. ....	.60	1.33	2.22	.38	4.54
Licenses & bonds.....	.01	--	.11	--	.12
Interest on investment.....	2.34	5.17	8.60	1.51	17.61
Total fixed cost.....	8.64	15.91	19.63	5.68	49.87
Variable costs:					
Direct labor.....	1.46	6.29	4.52	1.03	13.30
Administrative overhead....	.68	2.92	2.10	.48	6.17
Electricity.....	.10	.83	.40	.04	1.37
Dryer fuel.....	--	.98	--	--	.98
Truck expense.....	--	.95	--	--	.95
Building repairs.....	.01	.13	.44	.01	.58
Equipment repairs.....	.72	1.29	2.20	.52	4.73
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.33	1.49	1.10	.23	3.15
Interest on working capital:	.07	.29	.24	.05	.65
Total variable cost.....	3.37	15.16	11.23	2.36	32.12
Total cost.....	12.02	31.08	30.86	8.04	81.99
Out-of-pocket cost ^{3/}	4.08	16.74	13.96	2.81	37.59

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

^{1/} Costs in this table were obtained by dividing estimated total costs (app. table 18) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

^{2/} Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

^{3/} Excludes depreciation and interest on investment.

Table 7--Medium model, 10 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: : Drying :	: : Storing :	: Loading : out <u>2/</u>	: Total : cost
	<u>Cents per hundredweight</u>				
Fixed costs:					
Building depreciation.....	0.36	2.94	11.38	0.18	14.85
Equipment depreciation.....	10.79	18.82	9.22	7.40	46.24
Insurance--bldg. & equip....	.21	.56	1.00	.14	1.91
Taxes--bldg. & equip.	1.20	3.10	5.56	.80	10.66
Licenses & bonds.....	.01	--	.36	--	.37
Interest on investment.....	4.69	11.99	21.51	3.14	41.33
Total fixed cost.....	17.26	37.41	49.03	11.66	115.36
Variable costs:					
Direct labor.....	1.09	3.99	4.79	.66	10.53
Administrative overhead.....	5.07	4.04	4.97	4.68	18.77
Electricity.....	.11	.88	.48	.03	1.49
Dryer fuel.....	--	.91	--	--	.91
Truck expense.....	--	.93	--	--	.93
Building repairs.....	.01	.07	.26	<u>3/</u>	.34
Equipment repairs.....	.56	1.18	1.58	.38	3.70
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.76	1.34	1.37	.64	4.10
Interest on working capital:	.16	.30	.36	.13	.95
Total variable cost.....	7.76	13.64	14.05	6.53	41.97
Total cost.....	25.02	51.04	63.07	18.19	157.34
Out-of-pocket cost <u>4/</u>	9.18	17.29	20.96	7.47	54.92

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 19) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005.

4/ Excludes depreciation and interest on investment.

Table 8--Medium model, 20 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: Drying	: Storing	: Loading : out <u>2/</u>	: Total : cost
	Cents per hundredweight				
Fixed costs:					
Building depreciation.....	0.18	1.47	5.69	0.09	7.43
Equipment depreciation.....	5.40	9.41	4.61	3.70	23.12
Insurance--bldg. & equip. ...	.10	.28	.50	.07	.96
Taxes--bldg. & equip. ....	.60	1.55	2.78	.40	5.33
Licenses & bonds.....	<u>3/</u>	--	.18	--	.18
Interest on investment.....	2.35	6.00	10.75	1.57	20.67
Total fixed cost.....	8.63	18.70	24.51	5.83	57.68
Variable costs:					
Direct labor.....	1.01	3.09	2.92	.42	7.44
Administrative overhead.....	2.54	2.02	2.48	2.34	9.39
Electricity.....	.08	.70	.38	.03	1.18
Dryer fuel.....	--	.89	--	--	.89
Truck expense.....	--	.55	--	--	.55
Building repairs.....	.01	.07	.26	<u>3/</u>	.34
Equipment repairs.....	.51	1.09	1.44	.35	3.40
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.46	.94	.85	.35	2.60
Interest on working capital..	.09	.20	.21	.07	.57
Total variable cost.....	4.71	9.54	8.79	3.57	26.61
Total cost.....	13.34	28.24	33.31	9.40	84.29
Out-of-pocket cost <u>4/</u>	5.41	11.36	12.26	4.04	33.07

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 20) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005.

4/ Excludes depreciation and interest on investment.

Table 9---Medium model, 30 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : : truck :	Drying :	Storing :	:Loading : : out <u>2/</u> :	Total cost
	<u>Cents per hundredweight</u>				
Fixed costs:					
Building depreciation.....	0.12	0.98	3.79	0.06	4.95
Equipment depreciation.....	3.60	6.27	3.07	2.47	15.41
Insurance--bldg. & equip. ...	.07	.19	.33	.05	.64
Taxes--bldg. & equip. ....	.40	1.03	1.85	.27	3.55
Licenses & bonds.....	<u>3/</u>	--	.12	--	.12
Interest on investment.....	1.56	4.00	7.17	1.05	13.78
Total fixed cost.....	5.75	12.47	16.34	3.89	38.45
Variable costs:					
Direct labor.....	.99	3.15	2.28	.31	6.74
Administrative overhead.....	1.78	1.42	1.75	1.65	6.60
Electricity.....	.08	.63	.34	.02	1.07
Dryer fuel.....	--	.88	--	--	.88
Truck expense.....	--	.43	--	--	.43
Building repairs.....	.01	.07	.26	<u>3/</u>	.34
Equipment repairs.....	.47	.99	1.31	.32	3.09
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.37	.84	.68	.26	2.15
Interest on working capital :	.07	.17	.16	.05	.45
Total variable cost.....	3.77	8.57	7.04	2.61	21.99
Total cost.....	9.53	21.04	23.38	6.50	60.45
Out-of-pocket cost <u>4/</u>	4.25	9.79	9.35	2.92	26.31

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 21) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005.

4/ Excludes depreciation and interest on investment.

Table 10--Medium model, 40 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: Drying :	: Storing :	:Loading : out <u>2/</u> :	: Total : cost
	<u>Cents per hundredweight</u>				
Fixed costs:					
Building depreciation.....	0.09	0.74	2.84	0.04	3.71
Equipment depreciation.....	2.70	4.70	2.30	1.85	11.56
Insurance--bldg. & equip. ...	.05	.14	.25	.04	.48
Taxes--bldg. & equip. ....	.30	.77	1.39	.20	2.66
Licenses & bonds.....	<u>3/</u>	--	.09	--	.09
Interest on investment.....	1.17	3.00	5.38	.79	10.33
Total fixed cost.....	4.32	9.35	12.26	2.92	28.84
Variable costs:					
Direct labor.....	.85	2.43	1.96	.34	5.58
Administrative overhead.....	1.34	1.07	1.31	1.24	4.95
Electricity.....	.07	.59	.32	.02	1.01
Dryer fuel.....	--	.87	--	--	.87
Truck expense.....	--	.37	--	--	.37
Building repairs.....	.01	.07	.26	<u>3/</u>	.34
Equipment repairs.....	.42	.89	1.18	.29	2.78
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.30	.70	.58	.21	1.79
Interest on working capital :	.06	.14	.13	.04	.37
Total variable cost.....	3.05	7.12	6.00	2.14	18.31
Total cost.....	7.37	16.47	18.25	5.06	47.15
Out-of-pocket cost <u>4/</u>	3.41	8.03	7.73	2.38	21.55

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 22) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005.

4/ Excludes depreciation and interest on investment.

Table 11--Large model, 10 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: Drying	: Storing	: Loading : out <u>2/</u>	: Total : cost
	Cents per hundredweight				
Fixed costs:					
Building depreciation.....	0.32	2.19	9.64	0.14	12.28
Equipment depreciation.....	10.53	12.69	8.46	5.43	37.11
Insurance--bldg. & equip. ...	.20	.39	.88	.10	1.57
Taxes--bldg. & equip.	1.17	2.14	4.86	.59	8.77
Licenses & bonds.....	<u>3/</u>	--	.38	--	.39
Interest on investment.....	4.56	8.30	18.80	2.32	33.98
Total fixed cost.....	16.79	25.70	43.03	8.58	94.10
Variable costs:					
Direct labor.....	1.00	5.02	5.48	.70	12.20
Administrative overhead.....	3.02	2.41	2.96	2.79	11.18
Electricity.....	.08	.75	.38	.03	1.24
Dryer fuel.....	--	.73	--	--	.73
Truck expense.....	--	.56	--	--	.56
Building repairs.....	.01	.05	.22	<u>3/</u>	.28
Equipment repairs.....	.52	.94	1.26	.33	3.05
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.51	1.16	1.17	.43	3.28
Interest on working capital..	.11	.25	.31	.09	.76
Total variable cost.....	5.25	11.87	12.02	4.37	33.52
Total cost.....	22.04	37.57	55.06	12.95	127.62
Out-of-pocket cost <u>4/</u>	6.63	14.39	18.16	5.06	44.25

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 23) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005.

4/ Excludes depreciation and interest on investment.

Table 12--Large model, 20 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: Drying :	: Storing :	:Loading : out <u>2/</u> :	: Total : cost
	Cents per hundredweight				
Fixed costs:					
Building depreciation.....	0.16	1.09	4.82	0.07	6.14
Equipment depreciation.....	5.26	6.34	4.23	2.71	18.56
Insurance--bldg. & equip....	.10	.19	.44	.05	.79
Taxes--bldg. & equip. ....	.59	1.07	2.43	.30	4.38
Licenses & bonds.....	<u>3/</u>	--	.19	--	.19
Interest on investment.....	2.28	4.15	9.40	1.16	16.99
Total fixed cost.....	8.40	12.85	21.52	4.29	47.05
Variable costs:					
Direct labor.....	.39	4.05	3.27	.54	8.25
Administrative overhead....	1.58	1.26	1.55	1.46	5.85
Electricity.....	.07	.64	.32	.03	1.06
Dryer fuel.....	--	.72	--	--	.72
Truck expense.....	--	.37	--	--	.37
Building repairs.....	.01	.05	.22	<u>3/</u>	.28
Equipment repairs.....	.48	.86	1.16	.30	2.79
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.28	.88	.75	.26	2.17
Interest on working capital:	.06	.18	.18	.05	.47
Total variable cost.....	2.86	9.01	7.69	2.65	22.22
Total cost.....	11.26	21.86	29.21	6.94	69.27
Out-of-pocket cost <u>4/</u>	3.56	10.28	10.76	3.00	27.58

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 24) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005.

4/ Excludes depreciation and interest on investment.

Table 13--Large model, 30 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: Drying :	: Storing :	:Loading : out <u>2/</u>	: Total : cost
	<u>Cents per hundredweight</u>				
Fixed costs:					
Building depreciation.....	0.10	0.73	3.21	0.04	4.09
Equipment depreciation.....	3.51	4.23	2.82	1.81	12.37
Insurance--bldg. & equip....	.07	.13	.29	.03	.52
Taxes--bldg. & equip. ....	.39	.71	1.62	.20	2.92
Licenses & bonds.....	<u>3/</u>	--	.13	--	.13
Interest on investment.....	1.52	2.77	6.27	.77	11.32
Total fixed cost.....	5.60	8.57	14.34	2.86	31.37
Variable costs:					
Direct labor.....	.37	3.29	2.50	.44	6.60
Administrative overhead....	1.10	.88	1.08	1.02	4.08
Electricity.....	.07	.60	.30	.02	.99
Dryer fuel.....	--	.72	--	--	.72
Truck expense.....	--	.31	--	--	.31
Building repairs.....	.01	.05	.22	<u>3/</u>	.28
Equipment repairs.....	.43	.78	1.05	.27	2.53
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.22	.73	.59	.19	1.74
Interest on working capital:	.05	.14	.14	.04	.37
Total variable cost.....	2.24	7.50	6.12	1.99	17.85
Total cost.....	7.84	16.07	20.46	4.85	49.22
Out-of-pocket cost <u>4/</u>	2.71	8.34	8.16	2.23	21.44

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 25) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005

4/ Excludes depreciation and interest on investment.

Table 14--Large model, 40 percent average occupancy: Estimated average cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971 1/

Cost item	:Receiving: : by : truck	: : Drying : : : :	: Storing : : : :	: Loading : out <u>2/</u> : :	: Total : cost : :
	Cents per hundredweight				
Fixed costs:					
Building depreciation.....	0.08	0.55	2.41	0.03	3.07
Equipment depreciation.....	2.63	3.17	2.12	1.36	9.28
Insurance--bldg. & equip. ...	.05	.10	.22	.03	.39
Taxes--bldg. & equip. ....	.29	.54	1.22	.15	2.19
Licenses & bonds.....	<u>3/</u>	--	.10	--	.10
Interest on investment.....	1.14	2.07	4.70	.58	8.49
Total fixed cost.....	4.20	6.42	10.76	2.14	23.53
Variable costs:					
Direct labor.....	.27	2.45	2.19	.30	5.22
Administrative overhead.....	.83	.66	.81	.76	3.06
Electricity.....	.06	.58	.29	.02	.96
Dryer fuel.....	--	.71	--	--	.71
Truck expense.....	--	.28	--	--	.28
Building repairs.....	.01	.05	.22	<u>3/</u>	.28
Equipment repairs.....	.39	.70	.94	.25	2.29
Insurance on rice.....	--	--	.09	--	.09
Taxes on rice.....	--	--	.03	--	.03
Fumigation.....	--	--	.12	--	.12
Other.....	.17	.60	.52	.15	1.45
Interest on working capital..	.04	.12	.12	.03	.30
Total variable cost.....	1.77	6.15	5.34	1.52	14.78
Total cost.....	5.97	12.58	16.10	3.66	38.31
Out-of-pocket cost <u>4/</u>	2.12	6.79	6.87	1.69	17.47

-- = No allocation of this cost item made to this function.

Sums of individual cost items may not total due to rounding.

1/ Costs in this table were obtained by dividing estimated total costs (app. table 26) by appropriate total annual receipts (app. table 8). See appendix for explanation of methodology and allocation procedure used in developing costs.

2/ Per unit cost of loading out is based on the weighted average of the estimated volumes of truck and rail loadout (app. table 9).

3/ Less than .005

4/ Excludes depreciation and interest on investment.

ECONOMIC RELATIONSHIPS

Volume-cost relationships and economies of scale are of special interest to plant management. In the short run, plant size cannot be readily changed; therefore, management is especially concerned with the influence of volume changes on costs of operating their existing facility. However, in the long run, management has sufficient opportunity to vary plant scale. Interest then turns to the question of what plant size is most suitable. Information on economies of scale can be helpful in answering this question.

Average Cost Curves

To illustrate the effects of volume changes on operating costs for each model rice dryer category, average total costs were plotted at four levels of annual receipts (fig. 2). Volume-reducing factors such as severe weather and reduction in acreage allotments can have a significant effect on average costs. For instance, assume there is a 5-percent reduction in annual receipts and that a commercial rice dryer comparable to the medium-size model is normally receiving 520,000 hundredweight of rough rice annually. At this volume level--about 1.688 times net storage capacity--average net revenue is approximately 6 cents per hundredweight and total net profit \$31,200 (fig. 2). ^{5/} Reducing annual volume 5 percent to 494,000 hundredweight drops net revenue to approximately 4 cents per hundredweight and total net profit to \$19,760.

Using the same volume level for the large model as was used for the medium model, annual receipts--before the 5-percent reduction in volume--would be about 1,024,000 hundredweight. Net revenue at this volume level is approximately 16 cents per hundredweight and total net profit \$163,840. Reducing annual receipts 5 percent to 972,800 hundredweight drops net revenue to approximately 14 cents per hundredweight and total net profits to \$136,192 (fig. 2). Thus, a 5-percent loss in annual receipts reduced profits of the large model by almost 17 percent, while a similar volume loss for the medium model reduced profits by nearly 37 percent.

Under normal conditions, a small plant already has a per unit cost disadvantage relative to a large plant. Therefore, it is placed in an especially perilous financial position by periods of low volume activity.

^{5/} The average net revenue of approximately 6 cents per hundredweight is determined by taking the difference between the average gross revenue line and the average cost curve. The assumed average gross revenue of 56 cents is based on a drying charge of 34 cents per hundredweight and an average storage charge of 22 cents per hundredweight, which are representative of charges in the Southern Region.

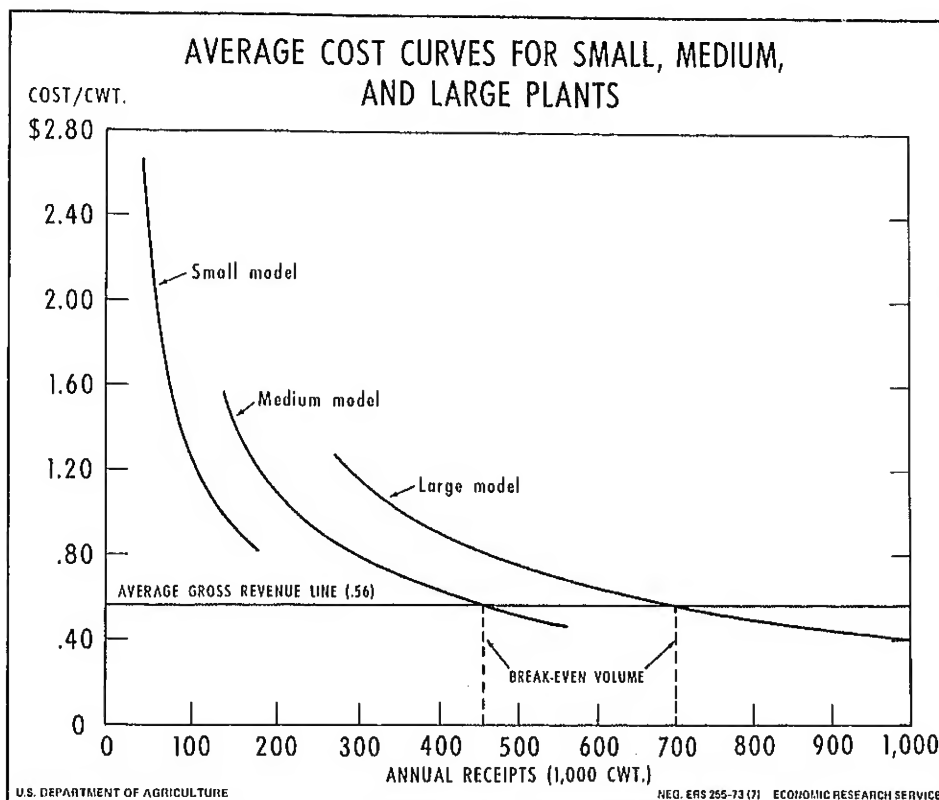


Figure 2

Economies of Scale

The reason small commercial rice dryers cannot compete effectively with large plants is illustrated by economies of scale (fig. 2). Based on an assumed average gross revenue of 56 cents per hundredweight, the medium and large facility could operate profitably at normal volume levels. However, a new facility comparable to the small model could not cover total costs at any feasible volume level.

Even a medium-size plant has little range over which it can effectively compete with the large firm. Break-even volume occurs at a higher ratio of annual receipts to net storage capacity for the medium than for the large dryer. Assuming an average gross revenue of 56 cents, the medium-size dryer would require annual rough rice receipts of approximately 455,000 hundredweight (1.48 times net storage capacity) to break even (fig. 2). The large dryer would require annual receipts of about 700,000 hundredweight (only 1.15 times net storage capacity) to break even.

APPENDIX

PROCEDURE AND METHODOLOGY USED TO DEVELOP BUILDING AND EQUIPMENT COSTS AND OPERATING COSTS

Building Costs

To determine construction costs for each plant, storage tank layouts and capacities were developed (see fig. A-1 and app. table 1). In addition to meeting actual storage capacity requirements, plant layout must provide adequate separation for moisture, rice type, and grade. Number and size of tanks and plant layout were discussed with rice dryer operators and design engineers to be sure they were practical from an operating standpoint.

After tank layout and design were finalized, estimates of construction costs were made using the procedure and methodology outlined in Boeckh Building Valuation Manual ^{1/} (app. table 2). Available building cost data and discussions with industry contacts relative to plant costs were used to check the validity of these calculations.

Equipment Costs

Expected daily receipts and drying requirements determine equipment requirements at commercial rice dryers. Peak daily receipts and normal drying routines were determined from actual data and from discussions with rice dryer managers. These data were used to design capacities of receiving and drying equipment for each of the three models. Other plant equipment, such as conveyors and scalpers, was sized to maintain a smooth flow of rice. Because these plants were designed with the capability of receiving, drying, turning, and shipping simultaneously, extra conveying equipment was required. Once all equipment requirements and specifications were determined (app. tables 3-5), costs of equipment (table 2), plus transportation and installation, were obtained from equipment manufacturers.

^{1/} Boeckh Building Valuation Manual, Volume 2, 1967, Commercial Building, Grain Elevator, Concrete, Boeckh Division, American Appraisal Co., Milwaukee, Wis.

Volume Estimates

Volume data obtained in 1965 from a sample of 24 Southern Region rice dryers were used to calculate selected ratios, which in turn were used as a basis for making volume estimates for the model rice dryers (app. tables 6-11). ^{2/} It was felt that the 1965 volume data would still be adequate for making volume estimates for the models since no significant changes have occurred in methods of handling, modes of transportation, or Government storage. Specific data and methodology used to determine functional volumes for the model dryers are as follows:

<u>Average annual receipts</u>	=	<u>520,847</u>	=	4.497971
Average monthly volume stored		115,796		
<u>Average truck shipments</u>	=	<u>186,150</u>	=	.412952
Average total shipments		450,779		
<u>Average rail shipments</u>	=	<u>264,629</u>	=	.587048
Average total shipments		450,779		
<u>Average annual volume turned</u>	=	<u>841,264</u>	=	7.265052
Average monthly volume stored		115,796		

Volume estimates for model plants:

Yearly volume stored = net storage capacity ^{3/} x 12 (mos.) x percent average occupancy level

Average monthly volume = $\frac{\text{yearly volume stored}}{12}$

Annual receipts = 4.497971 ^{4/} x average monthly volumes stored

Truck shipments = .412952 ^{4/} x annual receipts

Rail shipments = .587048 ^{4/} x annual receipts

Volume dried = annual receipts x .95 ^{5/}

Volume turned = 7.265052 ^{4/} x average monthly volume stored

^{2/} Dale L. Shaw, Shelby H. Holder, Jr., Charles A. Wilmot, and Zolon M. Looney, Cost of Commercial Drying, Storing, and Handling Rough Rice, 1965-66, U.S. Dept. Agr., Econ. Res. Serv., ERS-407, Washington, D.C., May 1969.

^{3/} Net storage volume from app. table 1.

^{4/} From ratio calculations.

^{5/} .95 was the average proportion of rough rice receipts dried at 24 commercial rice dryers sampled in the Southern Region in 1965.

OPERATING COSTS

Fixed Costs

Building depreciation--Buildings were depreciated at a straight line rate of 2.5 percent (40 years). This percentage was applied to allocated building costs to obtain depreciation cost for each function.

Equipment depreciation--This was charged at a straight line rate of 10 percent for all equipment, except tractors and trucks, which were charged off at 20 and 33.3 percent, respectively. These percentages were applied to allocated equipment costs.

Insurance on building and equipment--Insurance costs were based on information obtained from State insurance rating bureaus and local insurance agents. Rates were based on 90 percent co-insurance for an upright storage facility of concrete construction, located outside an incorporate municipality. The fire insurance rates used were 8.2 cents per \$100 valuation for the average rate and 10.55 cents for extended coverage. To determine total insurance costs and costs by function, these rates were applied to value of buildings and equipment for each of the three models.

Taxes--Information on assessed valuation and millage rates for commercial rice dryers was obtained from tax assessors in the southern rice-growing region. Based on these data, an assessed valuation of 20 percent of actual value and a tax rate of \$5.18 per \$100 valuation were used to determine taxes for each model plant. Taxes were charged to function based on building and equipment cost allocations.

Licenses and bonds--This cost estimate was based on data obtained from insurance agents, rice dryer operators, and economists in the Transportation and Warehouse Division, Agricultural Marketing Service, U.S. Department of Agriculture. Weighers' licenses were charged to receiving, and warehouse licenses and bonds to storage.

Interest on investment--Interest on investment was calculated at 8 percent of half the building and equipment costs. Interest on land investment cost was charged at 8 percent of total cost.

Variable Costs

Direct labor--Crew requirements, full-time and seasonal, were developed in consultation with commercial rice dryer operators. Pay scales, including fringe benefits, were obtained from the same source (app. table 12). Crew requirements, by function, were developed for the three models at each level of annual volume.

Once crew requirements were established for each function and at each level of average occupancy, total man-hour requirements were developed (app. table 13). The total number of man-hours, regular and overtime, for each crew member was multiplied by each crew member's regular and overtime wage rate to obtain total annual wages (app. table 14). Allocation of total wages was based on estimates of the proportion of total direct labor accounted for by each function.

Administrative overhead--Salaries for the manager and assistant bookkeeper of the small model were allocated by function in the same proportion as was direct labor, because they were included as a part of the regular crew. Administrative salaries, including clerical help, for the medium and large models were allocated to function based on survey data previously reported. ^{6/}

Electricity--Basically, electrical energy requirements were determined by multiplying horsepower for each function by hours required to handle specified volumes. Horsepower hours were multiplied by .7457 to convert them to kilowatt hours. ^{7/} Power costs were estimated by multiplying kilowatt hour requirements for each function by average rate charge for specified levels of energy use. Average rate charge was based on electrical rate schedules obtained from power companies.

Dryer fuel--Estimates of dryer fuel requirements were made by multiplying hours required for drying by average cubic feet of natural gas consumed per hour. Average gas consumption per hour was based on industry data for consumption rates for specified levels of temperature rise required for each pass through the dryer.

Dryer fuel costs were obtained by multiplying total cubic feet of natural gas consumed by average rate charged for specified levels of usage.

Truck expense--This expense is associated with hauling trash such as rice hulls, blanks, and straw. It was assumed that the small model, because of its relatively low volume of trash, could not justify truck ownership for this purpose. Thus, trash disposal was assumed to be contracted at a cost of 1 cent per hundredweight of rough rice dried. It was further assumed that the medium and large plant would own a 2-ton truck for this purpose. Annual fixed costs for operating a truck of this size were estimated at \$1,036 and variable costs at 0.19 cents per hundredweight of rough rice dried. Since most of the trash accumulates from the drying process, this truck expense was charged to drying.

^{6/} Shaw, op. cit., p. 23.

^{7/} .7457 is a conversion factor used to convert horsepower hours to kilowatt hours. (See Ralph G. Hudson's The Engineers' Manual, John Wiley and Sons, Inc., New York, N.Y., 1956, p. 327.)

Building and equipment repairs--Building and equipment repair costs were estimated at 1 percent of original investment cost. The total annual repair costs derived were then converted to cost per hundredweight, using the estimated receipts at the 30 percent average occupancy level. Total building and equipment repair costs for other occupancy levels were obtained by multiplying total receipts by this per unit cost. Approximately 10 percent of total repair cost was allocated to buildings and 90 percent to equipment. Building repairs were allocated by function in the same proportion as were building costs. Equipment repairs were allocated by function based on average percentage of total equipment costs and total operating hours accounted for by each function.

Insurance on rice--Information from State rating bureaus was used to estimate rice insurance costs. The rate used was 7.5 cents per \$100 valuation. Rough rice was valued at \$5.22 per hundredweight. Average value of rice in storage during the year was obtained by multiplying this price (\$5.22) by the average amount of rice on hand during the year. Estimated insurance cost was then derived by dividing the average value of rice on hand by \$100 and multiplying by 7.5 cents. Rice insurance cost was charged to storage.

Taxes on rice--Not all rice-growing States in the Southern Region tax rice in storage. Therefore, the rice tax can be excluded for those States not having such a tax. Rice tax was based on 0.35 cents per hundredweight of average occupancy. All of this cost was charged to storage.

Fumigation--Cost of fumigation was based on 0.56 cents per hundredweight of average occupancy. 8/ This cost was charged to storage.

Miscellaneous--An allowance was made for miscellaneous cost. It was computed as a percent of total variable cost in the same proportion as in a previous survey. 9/ The average for the Louisiana-Texas and Arkansas-Mississippi rice-growing regions in the study was applied to the model dryer total of all other variable costs to obtain miscellaneous costs. Volumes handled were used as a basis for allocating these costs to individual functions. Volume turned was used for storage volume.

Interest on working capital--This interest expense was calculated at 7 percent per year, borrowed quarterly. Allocation was made according to out-of-pocket costs applicable to each function.

Total Costs

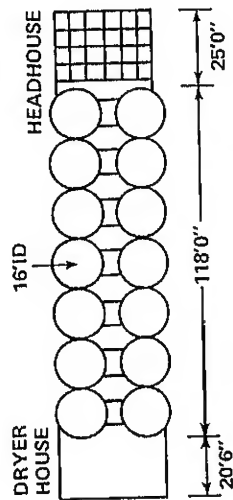
Total functional and combined costs were developed for each model at four levels of average occupancy (app. tables 15-26). Average costs per hundredweight were obtained by dividing these total costs by estimated annual receipts.

8/ Shaw, op. cit., p. 23.

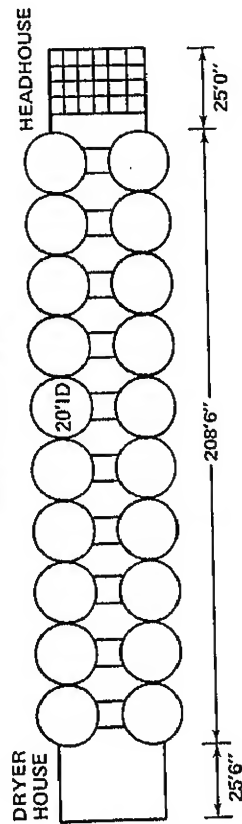
9/ Ibid.

MODEL LAYOUTS FOR RICE DRYING AND STORAGE

SMALL



MEDIUM



LARGE

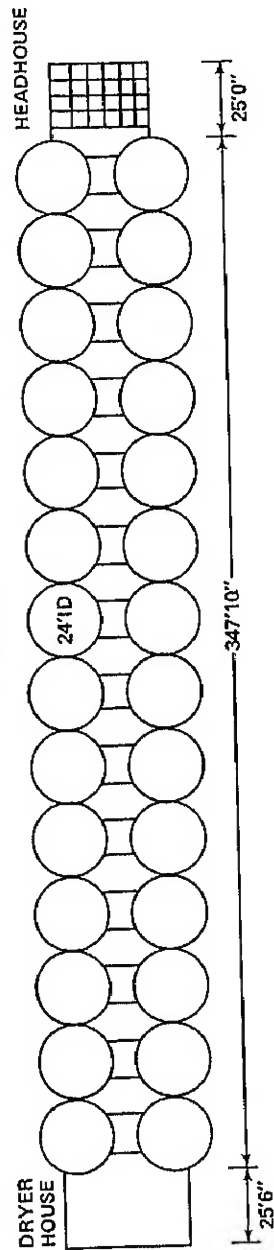


Figure A-1

Table A-1--Estimated storage capacity for model commercial rice drying facilities, by model size and bin type

Model size and bin type	Number of bins	Bin size		Storage capacity		
		Diameter	Height	Per bin <u>1/</u>	Total	Net <u>2/</u>
		- - - Feet - - -		- - - - Cwt. - - - -		
Small:						
Round.....	14	16	75	5,315	74,410	69,095
Interstice....	13	--	75	3,242	20,561	17,319
Headhouse.....	24	--	60	526	12,624	12,098
Total.....	51	--	--	9,083	107,595	98,512
Medium:						
Round.....	20	20	105	12,073	241,460	229,387
Interstice....	19	--	105	7,199	67,220	60,021
Headhouse.....	24	--	90	806	19,344	18,538
Total.....	63	--	--	20,078	328,024	307,946
Large:						
Round.....	28	24	105	17,158	480,424	463,266
Interstice....	27	--	105	10,114	134,933	124,819
Headhouse.....	24	--	90	806	19,344	18,538
Total.....	79	--	--	28,078	634,701	606,623

-- = Not applicable.

1/ Total unadjusted unit storage capacity plus or minus adjustments for hopper bottoms, angle of repose, and pack.

2/ Total storage capacity less working space. Working space based on 1 bin of each size.

Table A-2--Estimated cost of storage tanks and headhouses of monolithic concrete construction, commercial rice drying and storing facilities, by model size, Southern Region, 1971

Item	Unit	Model size		
		Small	Medium	Large
Storage tanks and interstices:				
Linear feet of wall.....	Foot	798.1	1,422.0	2,385.7
Cost/linear foot <u>1</u> /.....	Dollar	249.45	312.50	333.89
Total cost.....	Dollar	199,086	444,375	796,561
Receiving headhouse:				
Upper--				
Linear feet of wall.....	Foot	122.0	117.0	117.0
Cost/linear foot.....	Dollar	145.94	260.48	260.48
Total cost.....	Dollar	17,805	30,476	30,476
Lower--				
Linear feet of wall.....	Foot	319.5	314.5	314.5
Cost/linear foot.....	Dollar	249.45	312.50	333.89
Total cost.....	Dollar	79,699	98,281	105,008
Dryer headhouse:				
Upper--				
Linear feet of wall.....	Foot	114.0	111.0	129.0
Cost/linear foot.....	Dollar	145.94	260.48	260.48
Total cost.....	Dollar	16,637	28,913	33,602
Lower--				
Linear feet of wall.....	Foot	80.0	77.0	89.0
Cost/linear foot.....	Dollar	249.45	312.50	333.89
Total cost.....	Dollar	19,956	24,062	29,716
Cupola:				
Linear feet.....	Foot	118.0	205.5	347.8
Cost/linear foot.....	Dollar	152.98	163.04	173.11
Cupola cost.....	Dollar	18,052	33,505	60,208
Grand total cost.....	Dollar	351,235	659,612	1,055,571

1/ All costs per linear feet were determined as follows: Boeckh's 1967 costs per linear foot (U.S. average) updated to 1971 and adjusted to Southern Region by formula 1967 cost (U.S. average)/linear foot for concrete construction times ratio of 1971 Southern index for concrete construction over 1967 U.S. index for concrete construction. Southern index was based on 4 cities--Little Rock, Ark.; New Orleans, La.; Jackson, Miss.; and Houston, Tex.

Table A-3--Small model: Equipment requirements for a commercial rice drying and storing facility, Southern Region, 1971

Equipment, by function	Specifications		Motor requirements		
	Number	Size	Number	Horsepower	Total horsepower
Receiving:					
Grading and sampling.....	1	--	--	--	--
Scales and dumper.....	1	10'x60'	2	25	50
Receiving conveyor.....	1	24"x40'	1	5	5
Receiving leg.....	1	14"x7"x135'	1	40	40
Scalper.....	1	24"x114"	1	3	3
			1	10	10
Distributing belt.....	1	24"x141'	1	10	10
Tripper.....	1	24"	--	--	--
Subtotal.....	--	--	--	--	118
Drying:					
Dryers.....	2	75,000 cfm	2	1	2
			2	50	100
Screw conveyor (dryer return) :	2	12"x2-7/16"x141'	2	20	40
Dryer legs--					
Green rice.....	2	9"x5"x95'	2	15	30
Dry rice.....	2	9"x5"x95'	2	15	30
Tunnel belts (dryer feed).....	2	18"x141'	2	7-1/2	15
Subtotal.....	--	--	--	--	217
Storage:					
Temperature system.....	1	1 drop/tank	--	--	--
Aeration system (manifold).....	2	1/20 cfm per bu.	2	20	40
Turning leg.....	1	10"x7"x135'	1	30	30
Turning belt.....	1	24"x141'	1	10	10
Subtotal.....	--	--	--	--	80
Loadout:					
Dump scales.....	1	10 bu.	--	--	--
Shipping leg.....	1	10"x7"x135'	1	30	30
Shipping belt.....	1	24"x141'	1	10	10
Loadout spouting (rail).....	1	10"	--	--	--
Spur track.....	1	400'	--	--	--
Capstan (car puller).....	1	3-car	1	5	5
Subtotal.....	--	--	--	--	45
Miscellaneous:					
Manlift.....	1	16"x135'	1	5	5
Spouting gates and turn heads :	various	--	--	--	--
Intercom system.....	1	6 stations	--	--	--
Air pollution control system..	2	--	2	30	60
Office equipment.....	--	--	--	--	--
Shop equipment.....	--	--	various	--	3
Electrical wiring.....	--	--	--	--	--
Tractor and implements.....	1	Medium	--	--	--
Truck.....	1	1/2-ton	--	--	--
Subtotal.....	--	--	--	--	68
Other:					
Contingency (5%).....	--	--	--	--	--
Grand total.....	--	--	--	--	528

-- = Not applicable.

Table A-4--Medium model: Equipment requirements for a commercial rice drying and storing facility, Southern Region, 1971

Equipment, by function	Specifications		Motor requirements		
	Number	Size	Number	Horsepower	Total horsepower
Receiving:					
Grading and sampling.....	--	--	--	--	--
Scales and dumper.....	1	10'x60'	2	25	50
Receiving conveyor.....	1	30"x40'	1	7-1/2	7-1/2
Receiving leg.....	1	16"x7"x195'	1	75	75
Scalper.....	2	24"x114"	2	3	6
			2	10	20
Distributing belt.....	1	30"x230'	1	20	20
Tripper.....	1	30"	--	--	--
Subtotal.....	--	--	--	--	178-1/2
Drying:					
Dryers.....	2	110,000 cfm	2	2	4
			2	60	120
Screw conveyor (dryer return)...	2	14"x3"x230'	1/ 4	25	100
Dryer legs--					
Green rice.....	2	10"x7"x125'	2	20	40
Dry rice.....	2	10"x7"x125'	2	20	40
Tunnel belts (dryer feed).....	2	24"x230'	2	20	40
Subtotal.....	--	--	--	--	344
Storage:					
Temperature system.....	1	1 drop/tank	--	--	--
Aeration system (manifold).....	4	1/20 cfm per bu.	4	30	120
Turning leg.....	1	12"x7"x195'	1	40	40
Turning belt.....	1	24"x230'	1	20	20
Subtotal.....	--	--	--	--	180
Loadout:					
Dump scales.....	1	25 bu.	--	--	--
Shipping leg.....	1	12"x7"x195'	1	40	40
Shipping belt.....	1	24"x230'	1	20	20
Loadout spouting and loader....	1	12"	--	--	--
Spur track.....	1	800'	--	--	--
Capstan (car puller).....	1	6-car	1	10	10
Subtotal.....	--	--	--	--	70
Miscellaneous:					
Manlift.....	1	16"x195'	1	7-1/2	7-1/2
Spouting gates and turn heads..	various	--	--	--	1
Intercom system.....	1	8 stations	--	--	--
Air pollution control system...	2	--	2	50	100
Office equipment.....	--	--	--	--	--
Shop equipment.....	--	--	various	--	5
Electrical wiring.....	--	--	--	--	--
Tractor.....	1	Medium	--	--	--
Truck.....	1	1/2-ton	--	--	--
	1	2-ton	--	--	--
Subtotal.....	--	--	--	--	113-1/2
Other:					
Contingency (5%).....	--	--	--	--	--
Grand total.....	--	--	--	--	886

-- = Not applicable.

1/ Each screw conveyor has a split drive; thus, two motors are required on each conveyor.

Table A-5--Large model: Equipment requirements for a commercial rice drying and storing facility, Southern Region, 1971

Equipment, by function	Specifications		Motor requirements		
	Number	Size	Number	Horsepower	Total horsepower
Receiving:					
Grading and sampling.....	--	--	--	--	--
Scales and dumper.....	2	10'x60'	4	25	100
Receiving conveyor.....	1	30"x40'	1	7-1/2	7-1/2
	1	30"x60'	1	10	10
Receiving leg.....	2	16"x7"x195'	2	75	150
Scalper.....	4	24"x114"	4	3	12
			4	10	40
Distributing belt.....	2	30"x372'	2	40	80
Tripper.....	2	30"	--	--	--
Subtotal.....	--	--	--	--	373-1/2
Drying:					
Dryers.....	2	114,000 cfm	2	2	4
			2	60	120
Screw conveyor (dryer return) :	2	16"x3-7/16"x372'	1/ 4	50	200
Dryer legs--					
Green rice.....	2	12"x7"x125'	2	30	60
Dry rice.....	2	12"x7"x125'	2	30	60
Tunnel belts (dryer feed).....	2	24"x372'	2	30	60
Subtotal.....	--	--	--	--	504
Storage:					
Temperature system.....	1	1 drop/tank	--	--	--
Aeration system (manifold)....	6	1/20 cfm per bu.	6	40	240
Turning leg.....	1	14"x7"x195'	1	40	40
Turning belt.....	1	30"x372'	1	30	30
Subtotal.....	--	--	--	--	310
Loadout:					
Dump scales.....	1	25 bu.	--	--	--
Shipping leg.....	1	14"x7"x195'	1	40	40
Shipping belt.....	1	30"x372'	1	30	30
Loadout spouting.....	1	12"	--	--	--
Spur track.....	1	1,000'	--	--	--
Capstan (car puller).....	1	6-car	1	10	10
Subtotal.....	--	--	--	--	80
Miscellaneous:					
Manlift.....	1	16"x195'	1	7-1/2	7-1/2
Spouting gates and turn heads :	various	--	--	--	1-1/2
Intercom system.....	1	12 stations	--	--	--
Air pollution control system :	2	--	2	60	120
Office equipment.....	--	--	--	--	--
Shop equipment.....	--	--	--	--	--
Electrical wiring.....	--	--	various	--	7
Tractor.....	1	Medium	--	--	--
Truck.....	1	1/2-ton	--	--	--
	1	2-ton	--	--	--
Subtotal.....	--	--	--	--	136
Other:					
Contingency (5%).....	--	--	--	--	--
Grand total.....	--	--	--	--	1,403-1/2

-- = Not applicable.

1/ Each screw conveyor has a split drive; thus, two motors are required on each conveyor.

Table A-6---Estimated hundredweight-months of storage, by model size and average occupancy level 1/

Average occupancy, percent	:	Model size		
		Small	Medium	Large
	:			
	:		<u>Cwt.</u>	
	:			
10	:	118,249	369,529	727,922
20	:	236,498	739,058	1,455,845
30	:	354,748	1,108,588	2,183,767
40	:	472,997	1,478,117	2,911,690
	:			

1/ Hundredweight-months of storage is equal to the sum of rice on hand at end of each month during the storage year. This figure was estimated by multiplying net storage capacity (app. table 1) times 12(months) times percent average occupancy. There is some rounding error due to conversion of net storage capacity from bushels to hundredweight.

Table A-7---Estimated average monthly volume stored, by model size and average occupancy level 1/

Average occupancy, percent	:	Model size		
		Small	Medium	Large
	:			
	:		<u>Cwt.</u>	
	:			
10	:	9,854	30,794	60,660
20	:	19,708	61,588	121,320
30	:	29,562	92,382	181,981
40	:	39,416	123,176	242,641
	:			

1/ Based on total hundredweight-months of storage, app. table 6, divided by 12 (months).

Table A-8--Estimated annual receipts, by model size and average occupancy level 1/

Average occupancy, percent	:	Model size		
		Small	Medium	Large
	:		<u>Cwt.</u>	
	:			
10	:	44,323	138,510	272,847
20	:	88,646	277,021	545,694
30	:	132,969	415,532	818,545
40	:	177,292	554,042	1,091,392
	:			

1/ Estimated by using the ratio of average monthly volume stored and average receipts from 24 southern rice dryers. This ratio (4.497971) was multiplied by average monthly volume stored (app. table 7).

Table A-10--Estimated annual volume passed through dryers, by model size and average occupancy level 1/

Average occupancy, percent	:	Model size		
		Small	Medium	Large
	:			
	:		<u>Cwt.</u>	
	:			
10	:	168,427	526,338	1,036,819
20	:	336,855	1,052,680	2,073,637
30	:	505,282	1,579,022	3,110,471
40	:	673,710	2,105,360	4,147,290
	:			

1/ Estimated by multiplying annual receipts (app. table 8) times 95 percent (average proportion of rough rice receipts dried at 24 commercial rice dryers in the Southern Region) times 4 (the average number of passes through the dryer).

Table A-11--Estimated annual volume turned, by model size and average occupancy level 1/

Average occupancy, percent	:	Model size		
		Small	Medium	Large
	:			
	:		<u>Cwt.</u>	
	:			
10	:	71,590	223,720	440,698
20	:	143,180	447,440	881,396
30	:	214,769	671,160	1,322,101
40	:	286,359	894,880	1,762,799
	:			

1/ Estimated by using the ratio of average monthly volume stored to volume turned by 24 commercial rice dryers in the Southern Region. This ratio (7.265052) was multiplied times average monthly volume stored (app. table 7).

Table A-12--Assumed salaries and pay rates at commercial rice dryers, by model size

Personnel	Annual salaries			Hourly pay rate ^{1/}		
	Model size			Model size		
	Small	Medium	Large	Small	Medium	Large
	<u>Dollars</u>					
Administrative and clerical:						
Manager.....	9,500	11,500	13,500	--	--	--
Foremen.....	--	9,500	11,500	--	--	--
Bookkeeper-secretary :	--	5,000	5,500	--	--	--
Asst. bookkeeper.....	--	--	--	1.81	1.81	1.81
Plant crew:						
Sampler.....	--	--	--	1.87	1.87	1.87
Grader.....	--	--	--	2.05	2.05	2.05
Weigher.....	--	--	--	1.87	1.87	1.87
Dump operator.....	--	--	--	1.87	1.87	1.87
Sweeper.....	--	--	--	1.87	1.87	1.87
Scalper operator.....	--	--	--	1.87	1.87	1.87
Bin setter.....	--	--	--	2.11	2.11	2.11
Asst. bin setter.....	--	--	--	1.87	1.87	1.87
Dryer operator.....	--	--	--	2.16	2.16	2.16
Asst. dryer operator.:	--	--	--	1.87	1.87	1.87
Loader.....	--	--	--	1.87	1.87	1.87
Tunnel man.....	--	--	--	1.87	1.87	1.87

-- = No allocation of this cost item made to this function.

^{1/} Includes fringe benefits.

Table A-13--Crew and manhour requirements for estimated levels of annual rough rice receipts, by model size

Model size	Estimated receipts ^{1/}	Crew requirements ^{2/}			Manhour requirements ^{3/}		
		Regular	Seasonal	Total	Regular crew	Seasonal crew	Total
	<u>Gwt.</u>			<u>Number</u>			
Small	44,323	^{4/} 3	--	3	7,824	--	7,824
	88,646	3	1	4	7,824	672	8,496
	132,969	3	4	7	7,824	2,688	10,512
	177,292	3	8	11	7,824	5,376	13,200
Medium	138,510	3	2	5	7,824	1,344	9,168
	277,021	3	6	9	7,824	4,032	11,856
	415,532	3	11	14	7,824	7,392	15,216
	554,042	3	13	16	7,824	8,736	16,560
Large	272,847	6	3	9	15,648	2,016	17,664
	545,694	6	11	17	15,648	7,392	23,040
	818,545	6	17	23	15,648	11,424	27,072
	1,091,392	6	19	25	15,648	12,768	28,416

-- = None.

^{1/} From app. table 8.

^{2/} Based on industry contact. Except for small model, manager not included as part of crew. Clerical excluded from crew at all plants.

^{3/} Hours worked by regular crew members estimated at 2,608 hours annually (84 days x 12 hours plus 200 days x 8 hours). Harvest crew hours calculated at 672 (56 days x 12 hours).

^{4/} For small model, manager included in regular crew at all levels of receipts.

Table A-14--Total annual wages and salaries for model rice dryers of specified sizes, by model size and average occupancy

Model size	Av. occupancy	: Estimated receipts : 2/	: Total employees : 3/	Salaries and wages 1/					Total
				: Administrative : 4/	: Clerical : 5/	: Regular employees 6/			
						: Regular time :	: Overtime :	: Total :	
Dollars									
Small									
: 10	: 44,323	: 3	: 9,500	: —	: 9,975	: 1,659	: —	: 11,634	: 21,134
: 20	: 88,646	: 4	: 9,500	: —	: 9,975	: 1,659	: 726	: 13,108	: 22,608
: 30	: 132,969	: 8	: 9,500	: 1,434	: 9,975	: 1,659	: 2,975	: 17,673	: 28,607
: 40	: 177,292	: 12	: 9,500	: 1,434	: 9,975	: 1,659	: 5,880	: 23,570	: 34,504
Medium									
: 10	: 138,510	: 7	: 21,000	: 5,000	: 9,975	: 1,659	: 1,452	: 14,582	: 40,582
: 20	: 277,021	: 11	: 21,000	: 5,000	: 9,975	: 1,659	: 4,428	: 20,622	: 46,622
: 30	: 415,532	: 17	: 21,000	: 6,434	: 9,975	: 1,659	: 8,059	: 27,993	: 55,427
: 40	: 554,042	: 19	: 21,000	: 6,434	: 9,975	: 1,659	: 9,512	: 30,942	: 58,376
Large									
: 10	: 272,847	: 11	: 25,000	: 5,500	: 24,738	: 4,115	: 2,179	: 33,276	: 63,776
: 20	: 545,694	: 20	: 25,000	: 6,934	: 24,738	: 4,115	: 7,989	: 45,070	: 77,004
: 30	: 818,545	: 27	: 25,000	: 8,368	: 24,738	: 4,115	: 12,788	: 54,058	: 87,426
: 40	: 1,091,392	: 29	: 25,000	: 8,368	: 24,738	: 4,115	: 14,284	: 57,006	: 90,374

1/ See app. table 12 for salaries and wage rates.

2/ Based on data from app. table 8.

3/ Includes all employees--administrative, clerical, and plant.

4/ Based on 2,608 total annual hours, of which 2,336 are at regular hourly rate and 272 at time and one-half. These hours times average wage rates equals total wage.

5/ Based on 672 total seasonal hours, of which 400 are at regular hourly rate and 272 at time and one-half.

6/ Administrative plus clerical plus wages.

Table A-15--Small model, 10 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	:Drying:	:Storing:	:Loading out	:Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	283	2,375	7,893	138	10,689
Equipment depreciation.....	9,644	13,884	6,831	6,455	36,814
Insurance--bldg. & equip. ...	187	425	710	121	1,443
Taxes--bldg. & equip.	1,062	2,364	3,938	682	8,046
Licenses & bonds.....	11	--	194	--	205
Interest on investment.....	4,140	9,168	15,245	2,673	31,226
Total fixed cost.....	15,327	28,216	34,811	10,069	88,423
Variable costs:					
Direct labor.....	1,065	3,894	5,705	970	11,634
Administrative overhead.....	870	3,180	4,658	792	9,500
Electricity.....	80	673	326	37	1,116
Dryer fuel.....	--	487	--	--	487
Truck expense.....	--	421	--	--	421
Building repairs.....	6	57	193	3	259
Equipment repairs.....	427	760	1,302	307	2,796
Insurance on rice.....	--	--	39	--	39
Taxes on rice.....	--	--	13	--	13
Fumigation.....	--	--	55	--	55
Other.....	272	1,055	1,366	235	2,928
Interest on working capital :	70	233	324	55	682
Total variable cost.....	2,790	10,760	13,981	2,399	29,930
Total cost.....	18,117	38,976	48,792	12,468	118,353
Out-of-pocket cost <u>1/</u>	4,050	13,549	18,823	3,202	39,624

-- = No allocation of this cost item made to this function.
1/ Excludes depreciation.

1/ Excludes depreciation and interest on investment.

Table A-16--Small model, 20 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	: Drying :	: Storing :	: Loading out :	Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	283	2,375	7,893	138	10,689
Equipment depreciation.....	9,644	13,884	6,831	6,455	36,814
Insurance--bldg. & equip. ...	187	425	710	121	1,443
Taxes--bldg. & equip.	1,062	2,364	3,938	682	8,046
Licenses & bonds.....	11	--	194	--	205
Interest on investment.....	4,140	9,168	15,245	2,673	31,226
Total fixed cost.....	15,327	28,216	34,811	10,069	88,423
Variable costs:					
Direct labor.....	1,107	4,210	6,795	996	13,108
Administrative overhead.....	802	3,051	4,925	722	9,500
Electricity.....	115	962	466	53	1,596
Dryer fuel.....	--	904	--	--	904
Truck expense.....	--	842	--	--	842
Building repairs.....	12	114	386	6	518
Equipment repairs.....	783	1,393	2,386	564	5,126
Insurance on rice.....	--	--	77	--	77
Taxes on rice.....	--	--	27	--	27
Fumigation.....	--	--	110	--	110
Other.....	314	1,278	1,684	260	3,536
Interest on working capital ..	77	272	380	60	789
Total variable cost.....	3,210	13,026	17,236	2,661	36,133
Total cost.....	18,537	41,242	52,047	12,730	124,556
Out-of-pocket cost <u>1/</u>	4,470	15,815	22,078	3,464	45,827

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-- = No allocation of this cost item made to this function.
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1/ Excludes depreciation and interest on investment.

Table A-17--Small model, 30 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	Drying	:Storing	:Loading out	Total cost
					Dollars
Fixed costs:					
Building depreciation.....	283	2,375	7,893	138	10,689
Equipment depreciation.....	9,644	13,884	6,831	6,455	36,814
Insurance--bldg. & equip. ..	187	425	710	121	1,443
Taxes--bldg. & equip.	1,062	2,364	3,938	682	8,046
Licenses & bonds.....	11	--	194	--	205
Interest on investment.....	4,140	9,168	15,245	2,673	31,226
Total fixed cost.....	15,327	28,216	34,811	10,069	88,423
Variable costs:					
Direct labor.....	1,658	7,379	7,602	1,035	17,674
Administrative overhead.....	1,026	4,565	4,703	640	10,934
Electricity.....	145	1,221	591	67	2,024
Dryer fuel.....	--	1,321	--	--	1,321
Truck expense.....	--	1,263	--	--	1,263
Building repairs.....	18	171	579	9	777
Equipment repairs.....	1,068	1,899	3,253	769	6,989
Insurance on rice.....	--	--	116	--	116
Taxes on rice.....	--	--	40	--	40
Fumigation.....	--	--	165	--	165
Other.....	436	1,984	1,891	280	4,591
Interest on working capital..	98	395	416	63	972
Total variable cost.....	4,449	20,198	19,356	2,863	46,866
Total cost.....	19,776	48,414	54,167	12,932	135,289
Out-of-pocket cost <u>1/</u>	5,709	22,987	24,198	3,666	56,560

-- = No allocation of this cost item made to this function.
1/ Excludes 100% of the cost of the item.

1/ Excludes depreciation and interest on investment.

Table A-18--Small model, 40 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	:Drying:	:Storing:	:Loading out	:Total Cost
			Dollars		
Fixed costs:					
Building depreciation.....	283	2,375	7,893	138	10,689
Equipment depreciation.....	9,644	13,884	6,831	6,455	36,814
Insurance--bldg. & equip. ...	187	425	710	121	1,443
Taxes--bldg. & equip.	1,062	2,364	3,938	682	8,046
Licenses & bonds.....	11	--	194	--	205
Interest on investment.....	4,140	9,168	15,245	2,673	31,226
Total fixed cost.....	15,327	28,216	34,811	10,069	88,423
Variable costs:					
Direct labor.....	2,586	11,154	8,009	1,822	23,571
Administrative overhead.....	1,200	5,174	3,715	845	10,934
Electricity.....	175	1,470	712	80	2,437
Dryer fuel.....	--	1,738	--	--	1,738
Truck expense.....	--	1,684	--	--	1,684
Building repairs.....	24	227	772	12	1,035
Equipment repairs.....	1,281	2,280	3,904	923	8,388
Insurance on rice.....	--	--	154	--	154
Taxes on rice.....	--	--	53	--	53
Fumigation.....	--	--	221	--	221
Other.....	586	2,642	1,943	410	5,581
Interest on working capital :	124	510	426	85	1,145
Total variable cost.....	5,976	26,879	19,909	4,177	56,941
Total cost.....	21,303	55,095	54,720	14,246	145,364
Out-of-pocket cost <u>1</u> /.....	7,236	29,668	24,751	4,980	66,635

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-- = No allocation of this cost item made to this function.
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1/ Excludes depreciation and interest on investment.

Table A-19--Medium model, 10 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	:Drying:	:Storing:	:Loading: out	:Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	492	4,075	15,761	247	20,575
Equipment depreciation.....	14,951	26,067	12,773	10,250	64,041
Insurance--bldg. & equip.....	289	773	1,390	195	2,647
Taxes--bldg. & equip.	1,668	4,287	7,698	1,112	14,765
Licenses & bonds.....	11	--	502	--	513
Interest on investment.....	6,501	16,609	29,786	4,352	57,248
Total fixed cost.....	23,912	51,811	67,910	16,156	159,789
Variable costs:					
Direct labor.....	1,512	5,524	6,638	908	14,582
Administrative overhead.....	7,028	5,603	6,880	6,489	26,000
Electricity.....	147	1,216	660	47	2,070
Dryer fuel.....	--	1,263	--	--	1,263
Truck expense.....	--	1,285	--	--	1,285
Building repairs.....	9	94	367	5	475
Equipment repairs.....	776	1,642	2,183	530	5,131
Insurance on rice.....	--	--	121	--	121
Taxes on rice.....	--	--	42	--	42
Fumigation.....	--	--	172	--	172
Other.....	1,055	1,851	1,892	888	5,686
Interest on working capital..	219	412	500	178	1,309
Total variable cost.....	10,746	18,890	19,455	9,045	58,136
Total cost.....	34,658	70,701	87,365	25,201	217,925
Out-of-pocket cost <u>1</u> /.....	12,714	23,950	29,045	10,352	76,061

-- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.

Table A-20--Medium model, 20 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: : by : truck	: Drying : :	: Storing: :	: Loading : out :	Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	492	4,075	15,761	247	20,575
Equipment depreciation.....	14,951	26,067	12,773	10,250	64,041
Insurance--bldg. & equip. ...	289	773	1,390	195	2,647
Taxes--bldg. & equip.	1,668	4,287	7,698	1,112	14,765
Licenses & bonds.....	11	--	502	--	513
Interest on investment.....	6,501	16,609	29,786	4,352	57,248
Total fixed cost.....	23,912	51,811	67,910	16,156	159,789
Variable costs:					
Direct labor.....	2,807	8,566	8,078	1,171	20,622
Administrative overhead.....	7,028	5,603	6,880	6,489	26,000
Electricity.....	233	1,928	1,046	75	3,282
Dryer fuel.....	--	2,456	--	--	2,456
Truck expense.....	--	1,535	--	--	1,535
Building repairs.....	17	188	735	10	950
Equipment repairs.....	1,424	3,009	4,002	971	9,406
Insurance on rice.....	--	--	241	--	241
Taxes on rice.....	--	--	83	--	83
Fumigation.....	--	--	345	--	345
Other.....	1,281	2,593	2,368	970	7,212
Interest on working capital	258	541	584	192	1,575
Total variable cost.....	13,048	26,419	24,362	9,878	73,707
Total cost.....	36,960	78,230	92,272	26,034	233,496
Out-of-pocket cost <u>1</u> /.....	15,016	31,479	33,952	11,185	91,632

-- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.

Table A-21--Medium model, 30 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	:Drying:	:Storing:	:Loading: out	Total cost
	:	:	Dollars	:	:
Fixed costs:	:	:	:	:	:
Building depreciation.....	492	4,075	15,761	247	20,575
Equipment depreciation.....	14,951	26,067	12,773	10,250	64,041
Insurance--bldg. & equip. ..	289	773	1,390	195	2,647
Taxes--bldg. & equip.	1,668	4,287	7,698	1,112	14,765
Licenses & bonds.....	11	--	502	--	513
Interest on investment.....	6,501	16,609	29,786	4,352	57,248
Total fixed cost.....	23,912	51,811	67,910	16,156	159,789
Variable costs:	:	:	:	:	:
Direct labor.....	4,132	13,073	9,492	1,296	27,993
Administrative overhead.....	7,416	5,912	7,259	6,847	27,434
Electricity.....	316	2,610	1,415	101	4,442
Dryer fuel.....	--	3,649	--	--	3,649
Truck expense.....	--	1,785	--	--	1,785
Building repairs.....	26	282	1,102	15	1,425
Equipment repairs.....	1,942	4,102	5,458	1,325	12,827
Insurance on rice.....	--	--	362	--	362
Taxes on rice.....	--	--	125	--	125
Fumigation.....	--	--	517	--	517
Other.....	1,540	3,497	2,841	1,067	8,945
Interest on working capital	303	699	668	209	1,879
Total variable cost.....	15,675	35,609	29,239	10,860	91,383
Total cost.....	39,587	87,420	97,149	27,016	251,172
Out-of-pocket cost <u>1</u> /.....	17,643	40,669	38,829	12,167	109,308

-- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.

Table A-22--Medium model, 40 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	:Drying	:Storing	:Loading out	: Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	492	4,075	15,761	247	20,575
Equipment depreciation.....	14,951	26,067	12,773	10,250	64,041
Insurance--bldg & equip.	289	773	1,390	195	2,647
Taxes--bldg. & equip.	1,668	4,287	7,698	1,112	14,765
Licenses & bonds.....	11	--	502	--	513
Interest on investment.....	6,501	16,609	29,786	4,352	57,248
Total fixed cost.....	23,912	51,811	67,910	16,156	159,789
Variable costs:					
Direct labor.....	4,737	13,460	10,864	1,881	30,942
Administrative overhead.....	7,416	5,912	7,259	6,847	27,434
Electricity.....	396	3,276	1,777	127	5,576
Dryer fuel.....	--	4,842	--	--	4,842
Truck expense.....	--	2,035	--	--	2,035
Building repairs.....	35	376	1,470	19	1,900
Equipment repairs.....	2,330	4,922	6,549	1,591	15,392
Insurance on rice.....	--	--	482	--	482
Taxes on rice.....	--	--	166	--	166
Fumigation.....	--	--	690	--	690
Other.....	1,660	3,877	3,226	1,165	9,928
Interest on working capital	324	766	736	226	2,052
Total variable cost.....	16,898	39,466	33,219	11,856	101,439
Total cost.....	40,810	91,277	101,129	28,012	261,228
Out-of-pocket cost <u>1</u> /.....	18,866	44,526	42,809	13,163	119,364

-- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.

Table A-23--Large model, 10 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: : by : truck	: Drying :	: Storing: :	: Loading : out	: Total : cost
			Dollars		
Fixed costs:					
Building depreciation.....	860	5,969	26,316	372	33,517
Equipment depreciation.....	28,737	34,622	23,091	14,807	101,257
Insurance--bldg. & equip. ..	556	1,053	2,397	281	4,287
Taxes--bldg. & equip.	3,200	5,843	13,267	1,618	23,928
Licenses & bonds.....	22	--	1,041	--	1,063
Interest on investment.....	12,437	22,638	51,303	6,326	92,704
Total fixed cost.....	45,812	70,125	117,415	23,404	256,756
Variable costs:					
Direct labor.....	2,715	13,690	14,961	1,910	33,276
Administrative overhead.....	8,244	6,573	8,070	7,613	30,500
Electricity.....	227	2,046	1,031	87	3,391
Dryer fuel.....	--	2,000	--	--	2,000
Truck expense.....	--	1,527	--	--	1,527
Building repairs.....	14	138	611	7	770
Equipment repairs.....	1,415	2,555	3,439	906	8,315
Insurance on rice.....	--	--	237	--	237
Taxes on rice.....	--	--	82	--	82
Fumigation.....	--	--	340	--	340
Other.....	1,404	3,176	3,188	1,172	8,940
Interest on working capital :	311	676	852	238	2,077
Total variable cost.....	14,330	32,381	32,811	11,933	91,455
Total cost.....	60,142	102,506	150,226	35,337	348,211
Out-of-pocket cost <u>1</u> /.....	18,108	39,277	49,516	13,832	120,733

-- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.

Table A-24--Large model, 20 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	:Drying:	:Storing:	:Loading: out	Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	860	5,969	26,316	372	33,517
Equipment depreciation.....	28,737	34,622	23,091	14,807	101,257
Insurance--bldg. & equip. ..	556	1,053	2,397	281	4,287
Taxes--bldg. & equip.	3,200	5,843	13,267	1,618	23,928
Licenses & bonds.....	22	--	1,041	--	1,063
Interest on investment.....	12,437	22,638	51,303	6,326	92,704
Total fixed cost.....	45,812	70,125	117,415	23,404	256,756
Variable costs:					
Direct labor.....	2,127	22,084	17,844	2,975	45,030
Administrative overhead.....	8,632	6,882	8,450	7,970	31,934
Electricity.....	388	3,493	1,760	148	5,789
Dryer fuel.....	--	3,931	--	--	3,931
Truck expense.....	--	2,020	--	--	2,020
Building repairs.....	29	276	1,222	13	1,540
Equipment repairs.....	2,593	4,683	6,304	1,663	15,243
Insurance on rice.....	--	--	475	--	475
Taxes on rice.....	--	--	164	--	164
Fumigation.....	--	--	679	--	679
Other.....	1,533	4,829	4,082	1,421	11,865
Interest on working capital :	334	964	1,009	282	2,589
Total variable cost.....	15,636	49,162	41,989	14,472	121,259
Total cost.....	61,448	119,287	159,404	37,876	378,015
Out-of-pocket cost <u>1</u> /.....	19,414	56,058	58,694	16,371	150,537

-- = No allocation of this cost item made to this function.

2/ Excludes depreciation and interest on investment.

Table A-25--Large model, 30 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: : by : truck	:Drying:	: Storing:	: Loading: : out	: Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	860	5,969	26,316	372	33,517
Equipment depreciation.....	28,737	34,622	23,091	14,807	101,257
Insurance--bldg. & equip. ...	556	1,053	2,397	281	4,287
Taxes--bldg. & equip.	3,200	5,843	13,267	1,618	23,928
Licenses & bonds.....	22	--	1,041	--	1,063
Interest on investment.....	12,437	22,638	51,303	6,326	92,704
Total fixed cost.....	45,812	70,125	117,415	23,404	256,756
Variable costs:					
Direct labor.....	3,060	26,942	20,456	3,600	54,058
Administrative overhead.....	9,019	7,191	8,829	8,329	33,368
Electricity.....	544	4,904	2,471	208	8,127
Dryer fuel.....	--	5,861	--	--	5,861
Truck expense.....	--	2,512	--	--	2,512
Building repairs.....	44	413	1,833	20	2,310
Equipment repairs.....	3,536	6,386	8,598	2,266	20,786
Insurance on rice.....	--	--	712	--	712
Taxes on rice.....	--	--	246	--	246
Fumigation.....	--	--	1,019	--	1,019
Other.....	1,787	6,004	4,829	1,595	14,215
Interest on working capital	378	1,170	1,143	312	3,003
Total variable cost.....	18,368	61,383	50,136	16,330	146,217
Total cost.....	64,180	131,508	167,551	39,734	402,973
Out-of-pocket cost <u>1</u> /.....	22,146	68,279	66,841	18,229	175,495

--- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.

Table A-26--Large model, 40 percent average occupancy: Estimated total cost for receiving, drying, storing, and loading out rough rice, Southern Region, 1971

Cost item	:Receiving: by truck	: Drying :	: Storing:	: Loading: out :	Total cost
			Dollars		
Fixed costs:					
Building depreciation.....	860	5,969	26,316	372	33,517
Equipment depreciation.....	28,737	34,622	23,091	14,807	101,257
Insurance--bldg. & equip. ...	556	1,053	2,397	281	4,287
Taxes--bldg. & equip.	3,200	5,843	13,267	1,618	23,928
Licenses & bonds.....	22	--	1,041	--	1,063
Interest on investment.....	12,437	22,638	51,303	6,326	92,704
Total fixed cost.....	45,812	70,125	117,415	23,404	256,756
Variable costs:					
Direct labor.....	2,993	26,782	23,954	3,278	57,007
Administrative overhead.....	9,019	7,191	8,829	8,329	33,368
Electricity.....	700	6,302	3,176	267	10,445
Dryer fuel.....	--	7,791	--	--	7,791
Truck expense.....	--	3,005	--	--	3,005
Building repairs.....	58	551	2,443	27	3,079
Equipment repairs.....	4,243	7,662	10,317	2,722	24,944
Insurance on rice.....	--	--	950	--	950
Taxes on rice.....	--	--	328	--	328
Fumigation.....	--	--	1,359	--	1,359
Other.....	1,894	6,601	5,655	1,628	15,778
Interest on working capital	397	1,274	1,290	317	3,278
Total variable cost.....	19,304	67,159	58,301	16,568	161,332
Total cost.....	65,116	137,284	175,716	39,972	418,088
Out-of-pocket cost <u>1/</u>	23,082	74,055	75,006	18,467	190,610

-- = No allocation of this cost item made to this function.

1/ Excludes depreciation and interest on investment.